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TITLE

PROVISION OF SHORT MESSAGE SERVICES

INVENTOR

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BACKGROUND OF THE INVENTION

Technical Field

This invention relates generally to Short Message Service operations in mobile cellular telecommunication networks. More particularly, this invention relates to a method to provide Short Message Service (SMS) services to mobile units roaming in a Signaling System #7 (SS7) network different from the Mobile Station (MS) home network.

History of Related Art

The Short Message Service (SMS) provides a means of sending text messages, containing up to 160 alphanumeric characters, to and from mobile stations. SMS makes use of a Message Center (MC), which acts as a store and forward center for short messages. The performance of different telecommunication network entities during an SMS operation is described in the American National Standards Institute (ANSI) -41 telecommunications standard, including the SMS Delivery Point to Point (DPTP) operation. This operation is defined as "a general purpose operation that is used to convey a short message or in general any other information or encapsulated data from one point to another point and report on the success or failure of that transfer."

When a MS registers at a Mobile Switching Center-Visitor Location Register (MSC-VLR), the MSC-VLR sends a Registration Notification Invoke (REGNOT) message to the Home Location Register (HLR). This message contains the address of the MSC currently serving the MS. This information is used by the HLR to find the MS. The MSC-VLR may provide the following ANSI-41 parameters in the REGNOT message: Point Code-Subsystem Number (PC-SSN), MSCIdentification (MSCID), MSCIdentificationNumber (MSCIN), and the SMS Address. Additionally, the Signaling Connection Control Part

(SCCP) address information, such as Point Code or Global Title Address (GTA), may be used by the HLR to locate the MS.

When a Short Message Entity (SME) receives a request to deliver an SMS, the SME sends the SMSDPTP Invoke message to the MC. When the destination of the Short Message is a MS, the MC requests the address of the serving MSC from the HLR. This may be accomplished using an ANSI-41 SMS Request Invoke (SMSREQ) message. Since the HLR already has the information regarding the MS location, it will respond to the SMSREQ message with the serving MSC Address. The address of the serving MSC (SMSC) is provided to the MC in the SMS Request Return Result (smsreq) in the ANSI-41 parameter "SMS Address."

This SMS Address may be the SMS Address parameter received in response to the REGNOT message, or the PC SSN, or the MSCID translated into a PC SSN, or even the lower layer SCCP information received during registration. With such information, the MC is able to send the SMS to the MSC, and the MSC forwards it to the MS via air interface, (typically TDMA or CDMA). The HLR can also provide the MS's Serving MSC Address using a SMS Notification (SMSNOT) message. This message is used when the MS is inactive at the time the HLR receives a SMSREQ message.

The preferred way to provide the SMS Address in the smsreq message is for the HLR to use the same SMS Address parameter received at REGNOT. Currently, the use of alternate addresses such as the MSCID, the PC-SSN, or the MSCIN to provide the SMS Address has disadvantages. For example, using the MSCID received during registration requires translation to a point code by the HLR, so its use may not be recommended. Using the PC-SSN parameter, or the lower layer address, may point to the VLR instead of the MSC when the MSC and VLR are different entities, thus creating confusion. Finally, the MSCIN parameter is not currently used by the HLR for SMS purposes, and is mainly used to let the HLR know that the MSC is International Roaming capable.

The SMS Address parameter has been modified in various usage standards, and it is suggested to use an E.212 address (taken from the International Telecommunication Union (ITU) Recommendation E.212 "International Identification Plan for Mobile Terminals and Mobile Users", incorporated herein by reference in its entirety) for international SMS message routing, and either an SS7 point code address or an E.212 address for national scenarios. When the MSC determines that the MS is roaming into a different SS7 network, the MSC may include its own E.212 address number in the SMS Address parameter in the REGNOT message. In this case, the HLR will populate the same SMS Address in the smsreq response message. This method is efficient for an international scenario, that is, when the MSC and MC are not connected by a common national signaling point code addressing scheme (i.e., utilize a different SS7 network type).

However, to provide SMS services to a national MS roaming in a different SS7 network, the MSC is required to provide the SMS Address with a Global Title Address (GTA) during registration, i.e., an E.212 GTA or E.164 (the ITU Recommendation E.164 "The International Public Telecommunication Numbering Plan", incorporated herein by reference in its entirety) GTA identifier, or a combination of these two identifiers. When a national roaming MS registers with the MSC, the MSC will typically provide a PC address in the SMS Address parameter in the REGNOT message (or the smsreq response). The HLR will store this address and provide it when a MC requests the address. However, a problem with this scenario occurs if the MC that issues the SMSREQ is in a different SS7 network type than the HLR (and therefore the S-MSC). The smsreq response from the HLR will include a PC in the SMS address provided by the MSC that is not recognized by the MC as the intended SMS address. Therefore, the SMSDPTP operation will not be possible.

Therefore, what is needed is a method which allows the HLR to determine the proper address for the MSC (or VLR) serving the roaming MS when requested by an external node. This method should enable communication between the external node and the MS,

MSC, or VLR, so as to provide proper addressing of SMS services to MSs roaming in an SS7 network that is different from the MS home network, and SMS reception from SS7 networks not being used by the MS.

SUMMARY OF THE INVENTION

The present invention relates to a method and apparatus to provide SMS services when different SS7 signaling networks are in use, both for SMS termination to mobile units roaming in an SS7 network different than the MS's home network, and for receiving SMS messages from an SS7 network different from the MS network when the MS is roaming inside or outside of its home SS7 network.

The HLR must store all relevant information related to the location of the MS, including the SMS Address and the MSCIN. The HLR must have the ability to determine which address needs to be provided to the requesting node. The SMS Address received at REGNOT will most probably contain a PC. For example, the REGNOT message contains a PC and the MSCIN, which in turn contains a country code. According to the method of the present invention, the HLR first analyzes the SMS Address for its country of origin to determine whether it is national or international. The HLR compares the MSCIN country code with the country code in the GTA provided in the calling party address of the MC (i.e., in the SMSREQ message) to determine whether the same point code scheme is used. The country codes do not need to be the same and some countries have more than one country code. If the country code is not present, it can be assumed by the HLR that the MC is in the same country (or region) as the HLR.

Absence of a MSCIN indicates that the roaming MS is national, since all international SMS addresses have a MSCIN. However, the MSC sometimes sends the MSCIN with a national roaming MS, even though it is not necessary. For a national roaming MS, the smsreq response is populated with the common point code from the SMS Address,

because the SMS Address will not have a GTA. Usually, the SMS Address will have a PC or GTA if international, and only a PC if national. The HLR has a database of country code and point code schemes [e.g., in ANSI-41 or International Telecommunication Union (ITU) Q.708 format, both incorporated herein by reference in their entirety] and knows the location of the MS and the external requesting node. The present invention allows the HLR to determine the proper address from this database for the MSC or VLR serving the MS when requested by an external node. In turn, this information enables the external node to easily address and communicate with the MS, MSC or VLR.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the structure and operation of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a prior art signal flow diagram illustrating the activity of different network entities during an SMS message delivery operation as defined in the ANSI-41 standard;

FIG. 2 is a prior art signal flow diagram illustrating successful SMS message delivery from a MC in a different SS7 network (international MC);

FIG. 3 is a prior art signal flow diagram illustrating unsuccessful SMS message delivery to a MS roaming in a different SS7 network (national MC);

FIG. 4 is a signal flow diagram illustrating various message pathways used in implementing the method of the present invention;

FIG. 5 is a flow chart illustrating the procedure utilized by the HLR to respond to a SMSREQ message for SMS service provision using the method of the present invention; and

FIG. 6 is a diagram illustrating the invention as a node having a database of country codes and point code schemes stored in a memory.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EXEMPLARY EMBODIMENTS

Figure 1 illustrates a prior art signal flow diagram illustrating the activity of different network entities during a SMS Delivery Point to Point operation as defined in the ANSI-41 standard. During this operation, a short message, encapsulated data, or other information is conveyed from one point to another, with a subsequent report on the success or failure of the transfer. A MS **10** supporting a SME **15** becomes known to a MSC **20** via registration or other system access in step **110**. The MSC **20** sends a REGNOT message to notify the VLR **30** of the location of a MS **10** in step **120**. The VLR **30** forwards the REGNOT message to the MS's **10** HLR **40** in step **130**. The HLR **40** records the SMS delivery address for the MS **10** and sends a regnot response to the VLR **30** containing subscriber profile information in step **140**. The VLR **30** forwards the regnot response to the serving MSC **20** in step **150**.

The MC **50** then receives and accepts a SMSDPTP message requesting delivery of a SMS message from a MS-based SME **60** in step **160**. The MC **50** responds with a smdptp positive acknowledgment (which may contain a SMS_BearerData parameter if there is bearer data to return) in step **170**. Because the MC **50** does not have a current, temporary SMS routing address and status for the addressed MS-based SME **15**, the MC **50** sends a SMSREQ message to the HLR **40** serving the MS **10** which contains the Mobile Identification Number (MIN) for the MS **10** associated with the SME **15** in step **180**. If the

HLR **40** does not have a current temporary SMS routing address and status for the addressed MS-based SME **15**, the HLR **40** forwards the SMSREQ message to the VLR **30** serving the MS **10** in step **190**. The VLR **30** forwards the SMSREQ message to the MSC **20** serving the MS **10** in step **200**. The MSC **20** sends a smsreq response containing the temporary SMS routing address for the served MS **10** in step **210**. The VLR **30** forwards the smsreq response to the HLR **40** in step **220**. The HLR **40**, in turn, sends the smsreq response to the MC **50** in step **230**.

The destination MC **50** forwards the SMDPTP to the destination MSC **20** using the temporary SMS routing address for the MS-based SME **15** in step **240**. The MSC **20** sends a SMS Air Interface Delivery (SMD) REQUEST to the destination SME **15** using the air interface address of the MS-based SME **15** in step **250**. The destination SME **15** responds with an automatic acknowledgment (SMD-ACK) which may include the SMS_BearerData parameter if there is data to return in step **260**. The MSC **20** translates the SMD-ACK into a smdptp positive acknowledgment and returns it to the source of the corresponding SMDPTP in step **270**. The smdptp may include a SMS_BearerData parameter if bearer data was provided in the destination SME **15** response.

Figure 2 is a prior art signal flow diagram illustrating unsuccessful SMS message delivery from a MC **52** residing in a different SS7 network (i.e., international MC). A MS **10** supporting a SME **12** becomes known to a MSC **20** via registration or other system access in step **310**. The MSC **20** sends a REGNOT message to notify the VLR **30** of the location of the MS **10** in step **320**. The VLR **30** forwards the REGNOT message to the MS's **10** HLR **40** in step **330**. The HLR **40** records the SMS delivery address for the MS **10** and

sends a regnot response to the VLR **30** containing subscriber profile information in step **340**. The VLR **30** forwards the regnot response to the serving MSC **20** in step **350**.

The MC **52** then receives and accepts a SMDPTP message from an international originator SME **62** requesting delivery of a SMS message to the MS-based SME **12** that is from a different SS7 network in step **360**. The MC **52** responds to the originator SME **62** with a smdptp positive acknowledgment (which may include a SMS_BearerData parameter if there is bearer data to return) in step **370**.

If the MC **52** does not have a current, temporary SMS routing address and status for the addressed MS-based SME **12**, the MC **52** then sends a SMSREQ message to the HLR **40** serving the MS **10**, containing the MIN for the MS **10** associated with the SME **12** in step **380**. In Figure 2, the Border MSC **45** is used as a SS7 gateway, translating the GTA provided in the Calling and Called Party Addresses to allow communication between the two different SS7 systems. If the HLR **40** does not have a current, temporary SMS routing address and status for the addressed MS-based SME **12**, the HLR **40** forwards the SMSREQ message to the VLR **30** serving the MS **10** in step **390**. The VLR **30** forwards the SMSREQ message to the MSC **20** serving the MS **10** which contains the addressed SME **12** in step **400**. The MSC **20** responds with a smsreq response containing the temporary SMS routing address for the served MS **10** in step **410,** this address contains the PC of the Serving MSC (S-MSC) **20**. The VLR **30** forwards the smsreq response to the HLR **40** in step **420,** and the HLR **40** forwards the smsreq response to the MC **52** in step **430**.

The Border MSC **45** translates the SCCP Global Title Addresses provided in the Called and Calling Party Address, and the destination MC **52** forwards the SMDPTP

message to the destination SME **12** using the temporary SMS routing address for the MS-based SME **12** in step **440**.

Since the routing of the SMSDPTP is done using Point Codes, and since the S-MSC **20** and the MC **52** are in different SS7 network types, the SMSDPTP is discarded by the Border MSC **45** (i.e., the gateway only translates GTA information).

Figure 3 illustrates successful prior art SMS message delivery to a MS **10** roaming in a different SS7 network type (i.e., national MC). A MS **10** supporting a SME **12** becomes known to a MSC **20** via registration or other system access in step **510**. The MSC **20** sends a REGNOT message to notify the VLR **30** of the location of the MS **10** in step **520**. The VLR **30** forwards the REGNOT message to the MS's HLR **40** that is in a different SS7 network in step **530**. This REGNOT message is sent using GTA so that the Border MSC **45** is able to translate the SCCP message header from one format to the other. The HLR **40** records the SMS delivery address for the MS **10** and responds with a regnot response to the VLR **30** containing subscriber profile information in step **540**. The regnot response is sent using GTA so that the Border **45** is able to translate the SCCP message header from one format to the other. The VLR **30** forwards the regnot response to the serving MSC **20** in step **550**.

The MC **54** then receives and accepts a SMDPTP from a national originator SME **64** requesting delivery of a SMS message to the MS-based SME **12** for the MS **10** that is roaming in a different SS7 network in step **560**. The MC **54** responds with a smdptp positive acknowledgment (which may include a SMS_BearerData parameter if there is bearer data to return) to the originator SME **64** in step **570**.

If the MC **54** does not have a current, temporary SMS routing address and status for the addressed MS-based SME **12**, the MC **54** sends a SMSREQ message to the HLR **40** serving the MS **10** which contains the addressed SME **12** in step **580**. If the HLR **40** does not have a current temporary SMS routing address and status for the addressed MS-based SME **12**, the HLR **40** forwards the SMSREQ message to the VLR **30** serving the MS **10** which contains the addressed SME **12** in step **590**. The VLR **30** then forwards the SMSREQ message to the MSC **20** serving the MS **10** which contains the addressed SME **12** in step **600**. The MSC **20** responds with a smsreq response containing the temporary SMS routing address for the served MS **10** in step **610**, and the VLR **30** forwards the smsreq response to the HLR **40** in step **620**. The HLR **40** then forwards the smsreq response to the MC **54** in step **630**.

The destination MC **54** then sends a SMDPTP message toward the destination SME **12** using the temporary SMS routing address for the MS-based SME **12** (i.e., the GTA of the Serving MSC **20**) in step **640**. This is accomplished using GTA, so that the Border MSC **45** is able to translate from one SS7 format to another. The MSC **20** sends an SMD-REQUEST message to the destination SME **12** using the air interface address of the MS-based SME **12** in step **650**. The destination SME **12** then responds with an automatic acknowledgment (SMD-ACK) in step **660,** which may include the SMS_BearerData parameter if there is data to return. The MSC **20** translates the SMD-ACK into a smdptp positive acknowledgment and returns it to the source of the corresponding SMDPTP in step **670**. The smdptp may include a SMS_BearerData parameter if bearer data was provided by the destination SME **12**. The smdptp is sent using GTA.

Figure 4 illustrates various message pathways used in implementing the method of the present invention. In general, the MS **10** accesses the telecommunication network at a node **20**, such as a MSC **20**, in step **710**. The MSC **20** then sends a REGNOT message to the VLR **30** with its address information in step **720** (e.g., SMSADDR, MSCIN, etc.). The VLR **30** forwards the REGNOT message including the address information in step **730**. The HLR **40** stores all the addresses that may be required by an external node, such as node X **70**, and answers with a regnot response in step **740**. The VLR **30** then forwards the response to the MSC **20** in step **750**.

At some later time, an external node X **70** may require the address of the Serving MSC **20** or VLR **30** in step **760**. The HLR **40** provides the proper address to the requesting node X **70** in step **770** based on its stored internal information and information acquired about the node requesting the address, including the location of the HLR **40**, the location of the Serving MSC-VLR, and the location of the requesting node. The node X **70** may then send a message (e.g., Y-message) to the MSC **20** or VLR **30** where the MS **10** is registered. The Y-message is sent to the MSC **20** or VLR **30** in step **780** depending on the X-node **70** needs, using the address obtained in step **770**. The MSC **20** or VLR **30** then responds to the node X **70** message in step **790**.

Figure 5 illustrates the procedure utilized by the HLR **40** to complete the smsreq response for providing SMS services according to the present invention. The HLR **40** receives a REGNOT message from the MSC **20** in step **810**. The HLR **40** then stores the SMS Address and MSCIN sent by an international roaming MS **10** in step **820**. The HLR **40** determines the nationality of the MC **56** in step **830**. Using the country code and point code scheme database **42** which is stored in a memory in the HLR **40**, a determination is made as

to whether the MC **56** and MSC **20** share the same point code scheme in step **840**. If so, the HLR **40** populates the smsreq response with the common point code from the SMS Address in step **850**. If not, the system populates the smsreq with the MSCIN in GTA format in step **860**.

Figure 6 is a diagram illustrating the invention as a node (HLR) **40** with a database **42** including a plurality of country codes and a corresponding plurality of point code schemes contained within a memory **41**. The database **42** includes point code schemes **43** such as ANSI and ITU, as well as the country codes **44** for each country. The HLR **40** utilizes this database **42** to compare the point code schemes for the MC **56** and the MSC **20** as previously described in Figure 5.

Although the invention has been described with reference to specific embodiments, this description is not meant to be construed in a limited sense. The various modifications of the disclosed embodiments, as well as alternative embodiments of the invention, will become apparent to persons skilled in the art upon reference to the description of the invention. It is, therefore, contemplated that the appended claims will cover such modifications that fall within the scope of the invention, or their equivalents.